UNCLASSIFIED

AD 295 988

Reproduced
by the

ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA

UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

CATALOGED BY ASTIA
AS AD No. 299888

63-23

AID Report P-63-11

14 January 1963

PHENOMENA IN THE UPPER ATMOSPHERE

Review of Soviet Literature

AID Work Assignment No. 3

ASTIA
RECEIVED
FEB 12 1963
TISIA

Aerospace Information Division
Library of Congress

AID Report P-63-11 14 January 1963

PHENOMENA IN THE UPPER ATMOSPHERE

Review of Soviet Literature

AID Work Assignment No. 3

The publication of this report does not constitute approval by any U. S. Government organization of the inferences, findings, and conclusions contained herein. It is published solely for the exchange and stimulation of ideas.

Aerospace Information Division
Library of Congress

FOREWORD

This is the thirtieth in a monthly report series reviewing Soviet developments in selected problems in astrophysics and geophysics. It is based on materials received at the Aerospace Information Division in October 1962.

Topics covered in this series are

I. Ionospheric electron concentrations
II. Solar radiation and the ionosphere
III. Van Allen belts and cosmic rays
IV. Telluric currents
V. Atmospheric electricity
VI. Nuclear bursts in the atmosphere
VII. Satellite and missile data
VIII. Arctic and antarctic communications
IX. Meteorology of the upper atmosphere

Materials in this report deal with topics II, III, IV, VII, and IX.

TOPIC II. SOLAR RADIATION AND THE IONOSPHERE

1) Karimov, M. G. Results of comparing systematic observations of the corona at different stations in 1961. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 76-80.

The results of observations of the green coronal line 5303 made in 1961 at the Mountain Station near Alma-Ata and at the Mountain Astronomical Station near Kislovodsk are reported. Soviet data are compared with those from the stations at Pic du Midi, Climax, Sacramento Peak, and Wendelstein. Although in the case of Soviet stations, absolute coincidence of intensities is required for purposes of comparing data, values between stations can differ because of: 1) the use of spectrographs having different dispersions and resolving power, 2) bad image quality caused by limb vibration or incorrect slit setting, 3)failure to focus on the condensation, and 4) brightness fluctuations of the corona. Data are presented graphically, and good agreement is seen between Soviet and Western data, particularly those from Pic du Midi. The agreement between the Soviet stations was greater than between the Soviet and Western stations. The best results were obtained in the Mountain Station near Alma-Ata. This is attributed to the improved dispersion of the spectrograph and to frequent replacement of the observers.

2) Karimov, M. G., and S. K. Dosybayev. Low-latitude filament and active prominences of 2 September 1961. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 81-85.

Motion pictures were made for several days of the active filament of 2 Sep 1961 with the АФР-2 chromosphere-photosphere telescope of the coronal station of the Astrophysical Institute of the Kazakh Academy of Sciences, located near Bol'shoye Almatinskoye lake at an elevation of 2600 m above sea level. The behavior of the active filament and prominences, as well as of the magnetic fields of observed sunspots, was studied during the period of several solar rotations. Analysis of observations shows that long before the strong outburst of the prominences on 2 September a spot had appeared which developed rapidly. The flare of 12 July took place around this spot and the emission of line 5303 was enhanced; coronal emission line 5694 appeared. Later, after half a solar rotation period, the filament appeared in the place of the spot and persisted for nearly half a solar rotation period. A spot arose in front of the filament after 24 hours. When the new spot was on the limb, two centers of active prominences arose. The most active

prominence, originally in the form of a single bright luminous formation, broke in two after activation, but continued to occupy the same area. This is believed to indicate that the forces controlling prominences are external and apparently associated with the magnetic field of the underlying spot. The activation of the prominence is apparently due to the flare immediately above the spot.

3) Karimov, M. G., and M. I. Antushevich. Flare and emission lines of the solar corona. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 86-92.

Attempts were made to carry out simultaneous investigations of flares and coronal emission lines. Several coronal emission lines were photographed in 1961 with a spectrograph having a dispersion of 7 A/mm, used in conjunction with the coronagraph of the coronal station located 2600 m above sea level. Motion pictures were made of chromospheric flares near the limb of the disk with the АФР-2 chromosphere-photosphere telescope. On the basis of the data obtained it was concluded: 1) The yellow coronal line 5694 A appears more active near flares; it is displaced 8 to 10° from the spots and occupies a considerably wider area than the spots. 2) In certain cases lines of different ionization potentials can coexist, which lends support to Elwert's view (reference given).

Comment: See also AID Work Assignment No. 3, Report 15, Topic II, Abstract 3.

4) Karimov, M. G., A. S. Zubtsov, M. I. Antushevich, and S. I. Dosybayev. Photometry of solar flares. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 93-106.

The results of the photometric processing of solar flares of intensity ≥ 2, observed from Oct 1957 to the end of 1959, are presented. The observations were made at the coronal station near Bol'shoye Almatinskoye lake, at an elevation of 2600 m, with the АФР-2 chromosphere-photosphere telescope. Motion pictures in the H_α line were made with an interference-polarization filter with a band-admission width of 0.6 A. Standard 35-mm panchromatic film of high sensitivity was used. The films were processed on the МФ-2 microphotometer to obtain the intensity and on the spectrophotometer to determine the area of the flare. Photographs and graphic data are provided.

5) Gringauz, K. I. Structure of the ionized gaseous envelope of the earth as determined by direct measurements of local concentrations of charged particles, carried out in the USSR. Iskusstvennyye sputniki zemli, no. 12, 1962, 105-118.

Experiments conducted in the outer ionosphere from Feb 1958 through Sep 1959 made it possible to determine the vertical distribution of the concentration of free electrons or (above the F-region maximum) the numerically equivalent concentration of positive ions. This distribution, owing to the period in which the experiments were conducted, reflects the state of the ionosphere in a period close to that of maximal solar activity.

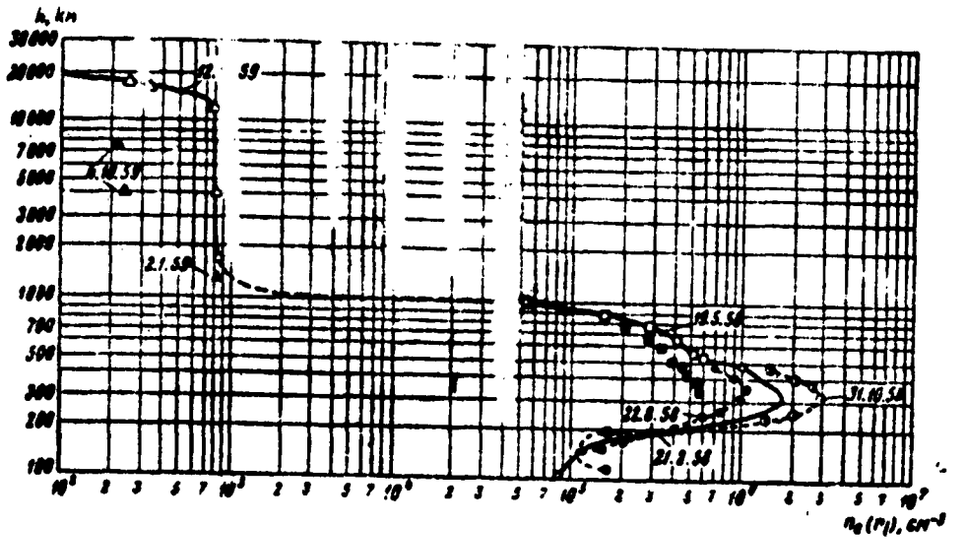

Fig. 1. Variation of charged-particle concentration with height in a period of near-maximal solar activity

The lower part of the diagram was constructed on the basis of data obtained by a geophysical rocket launched 21 Feb 1958; the middle part (from h = 500 km to h = 1000 km) was constructed from data obtained by the third artificial earth satellite during its 56th orbit; the part of the diagram from h = 1400 km to h = 20,000 km is based on data obtained by the second Soviet cosmic rocket. Near the main curve appear points based on data obtained by other rockets and satellites; to some degree these points characterize the changeability of the ionosphere. The substantial increase in negative gradients of concentration detected between 15,000 and 20,000 km near the boundary of the gaseous envelope has not yet been explained.

6) Jasiński, Stefan. Eclipse effects on the ionospheric E-layer observed at Miedzeszyn on 15 February 1961. Acta geophysica polonica, v. 10, no. 3, 1962, 225-237.

Ionospheric soundings were carried out in Miedzeszyn with the aid of a panoramic ionosonde of USSR manufacture during the solar eclipse of 15 February 1961. The coordinates

of the observation point are: $\varphi = +52^{\circ}10'$; $\lambda = -21^{\circ}12'$.

The variations of the critical frequencies f_0E of the ionospheric E-layer are assumed to be caused by the generation and loss of electrons in the recombination processes. The change of the electron density is determined by Chapman's continuity equation

$$\frac{dN}{dt} = q - \alpha' N^2, \tag{1}$$

where q is the electron production rate per volumetric unit during observations; N is the electron density, and α' is the effective recombination coefficient.

$$\alpha' = \alpha + \alpha_1 \frac{N-}{N},$$

where α is the coefficient of electron recombination with positive ions and α_1 is the coefficient of electron recombination with negative ions. N- is the density of negative ions. The daily variation of electron production in the Chapman layer occurs according to the formula

$$q = q_0 \cos^m \chi, \tag{2}$$

where q_0 is the electron production rate per volumetric unit in the subsolar point, χ is the solar zenith angle, and m = 1. Substituting (2) in formula (1), the author obtains

$$\frac{dN}{dt} = q_0 \cos^m \chi - \alpha' N^2. \tag{3}$$

A disturbed state of the ionosphere is considered a deviation of 20% or more from the ordinary critical frequency f_0F2 of the F2 layer, taken as the median value from 10 days of measurement.

The critical E-layer frequencies measured during the eclipse are presented graphically and compared with those computed theoretically at two α' values. The curve shows that the maximum of E-layer electron density precedes the maximum of optical eclipse. The author computes a theoretical value of the electron density in the E-layer, replacing the q of formula (1) by the q value for the eclipse day (q_e),

obtaining

$$q_e = Aq_c,$$

where A is the coefficient of visibility of the unocculted disks, i.e., the ratio of the visible uncovered part of the sun to the whole disk, and q_c is the production term of the control days median.

The theoretical electron density N_{theor} in the E-layer is computed by the formula

$$N^2_{theor} = \frac{Aq_c - \frac{dN_{me}}{dt}}{\alpha'},$$

where e indicates that the value refers to the eclipse day.

The theoretical curves computed at two values of α' differ markedly from the curve obtained experimentally during the eclipse. The disagreement is based, in the opinion of the author, on the following circumstances which were not taken into consideration: 1) The solar disk lacks uniform ionizing radiation; 2) a great deal of this radiation originates outside the visible solar disk; 3) the effective recombination coefficient changes during the eclipse in a manner as yet not precisely determined.

The author tries to explain the disagreement by a special model of the sun with two additional sickle-shaped regions in the equatorial belt outside the disk on the eastern and western sides. The sickles are formed by arcs with radii r equal to 0.9R (where R is the radius of the solar disk); their centers are shifted from the disk center by a distance of 0.2R. Five active regions of the sun are selected, containing sunspots and intense radiation of the green line of 5303A. The solar model with active centers is presented as it would be seen at a height of 100 km above the earth's surface.

Based on the solar model, the $N_{theor}(t)$ curve for $\alpha' = 1.5 \cdot 10^{-8}$ was computed and presented graphically. This curve is close to the experimental curve. The discrepancies are attributed to the instability of the E-layer. The minimum on the experimental curve is explained by the covering of the solar disk by the moon.

Author's Association: Institute of Communications, Warsaw.

Comment: The study of the effect of ionization of the E-layer by active solar regions is very important in ionospheric investigations and with regard to the safety of astronauts. The author's investigation is concerned only with certain sunspot groups and the intense radiation of the green line of 5303A during solar eclipse. The theoretical curve is approximated to the experimental by an arbitrarily selected α'. The results of this investigation are not conclusive enough to

make it possible to state that the ionization changes in the ionosphere are caused only by active regions on the sun.

7) Tsedilina, Ye. Ye. Doppler effect in a magnetically-active ionosphere. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 865-872.

The Doppler effect on radio frequencies in the ionosphere is examined, taking into account the influence of the terrestrial magnetic field. The author presents computations showing that the Doppler frequency shift Φ in a magnetically-active medium differs from that in an isotropic medium by a value proportional to ω_H/ω, where ω_H is the gyroscopic frequency. This additional term is insignificant with respect to the difference in the Doppler shift $\delta\Phi$ on coherent frequencies inasmuch as $(\omega_H/\omega) \ll 1$. For the Doppler rotational effect (or the Faraday effect) the influence of the additional term is quite substantial. When this term is taken into account, a change is observed in the character of the dependence of the rate of rotation of the polarization plane of the wave under consideration. Formulas are derived for differences in the Doppler shift $\delta\Phi_H$ and the angle of refraction $\delta\varphi$, taking into account the sphericity of the earth and the effect of the geomagnetic field.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Academy of Sciences USSR.

8) Shul'gina, N. V. Ionospheric disturbances as observed at Murmansk station. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 878-885.

Investigations of ionospheric disturbances from 1954 to 1960, i.e., through half a solar cycle, show that the disturbed state of the ionosphere changes with solar activity. Increased absorption (characterized by an increase of f_{min} or the absence of B reflections) and deviations of F2-layer critical frequencies from a median value were taken as indices of disturbance. Absorption is assumed to be caused chiefly by solar ultraviolet radiation. Disturbances were classified according to their duration and manner of development. It was found that during years of minimum solar activity small disturbances, i.e., disturbances of short duration, predominate, while in years of maximum activity large and very large disturbances prevail. Disturbances are classified as: D - those during which cases of increased or anomalous absorption and a sporadic-layer frequency $f_oE_s \geq 4.0$ mc are observed; D^+ - those which, apart from indices $f_{min} \geq 3.0$ mc, B, $F_oE_s \geq 4.0$ mc, show an increase over the sliding mean, exceeding 20%; D^- - those which, besides disturbances in the lower layers, exhibit a decrease of f_oF2 below the sliding mean, exceeding

20%; and $D^{\pm}$ - those in which disturbances occur in the lower layers and the F2 region. During the year of minimum solar activity, disturbance in the ionosphere was manifested chiefly in the appearance of the $f_0E_s \geq 4.0$ mc (almost always at night) and B absorption (more often in the daytime). Only a small fraction of them were connected with deviations of the critical frequency of the F2 layer from the median value. Type D is observed most often in the summer months; in winter it is recorded only half as often. D^+ disturbances predominate in winter; D^- and $D^{\pm}$ appear during equinoctial periods. Analysis of the moments of onset and termination of disturbances is useful in forecasting operating frequencies. It is concluded that ionospheric disturbances in the high latitudes, as well as changes of the quiet state, are controlled by phenomena occurring on the sun.

Author's Association: Polar Geophysical Institute, Academy of Sciences USSR (Kola Branch).

9) Bukin, G. V. Geographical distribution of f_0E and some properties of the E-region in the Antarctic. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 918-924.

The geographical distribution of f_0E in the Antarctic is examined on the basis of data from 18 ionospheric stations located between latitudes 30 and 90° S. Charts showing the median values of the critical frequencies of the E-layer were prepared. The isolines were found to be nonsymmetrical with respect to the noon meridian, i.e., there is apparently a disruption in the relationship of f_0E to the cosine of the zenith angle of the sun χ in the high latitudes. For a simple layer, values of f_0E are related to angle χ as follows:

$$(f_0E)^n = (f_0E)_0^n / \operatorname{ch}(R,\chi),$$

where f_0E is the value of the critical frequency of the E layer at $\chi = 0$; $\operatorname{ch}(R,\chi)$ is the Chapman function, accounting for the sphericity of the earth; $R = (R_0 + z)/H$; R_0 is the radius of the earth; z is the height of the E layer; H is the reduced height of a homogeneous atmosphere. Using tabulated values of $\operatorname{ch}(R,\chi)$, the dependence of $\ln f_0E$ on $\ln(1/\operatorname{ch}\chi)$ may be constructed, from which n may be determined. The results of computations are shown graphically. It is concluded that n depends on latitude; for the middle latitudes $n \approx 3$ and for the high latitudes $n \approx 4$. One possible reason for the anomalous behavior of the E-layer in the high latitudes is the additional ultraviolet ionization caused by corpuscular streams, particularly during twilight in the ionosphere. This is supported by the fact that n depends on geomagnetic, not geographic, coordinates.

Study of the geographic distribution of f_0E shows that the value of extra ionization in this layer, associated with geomagnetic coordinates, grows with latitude, reaching a maximum at geographic latitudes 70-80°. The deviation of variations of f_0E from the law of the cosine of the zenith angle of the sun, and also the relationship of f_0E in the high-latitude region to geomagnetic coordinates, point to the existence of a constant corpuscular background in the high-latitude region.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Academy of Sciences USSR.

Comment: See also AID Work Assignment No. 3, Report 27, Topic 2, Abstract 8.

10) Ivanov, K. G. Effect of local increase of conductivity of the E-layer of the ionosphere on the S_q-variation of the terrestrial magnetic field. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 943-948.

In investigating the magnetic effects of the Tunguska meteorite, the author concluded that subsequent decreases in the H- and Z-components were caused by an increase in the S_q-variation, owing to a local increase in the conductivity of the E-layer of the ionosphere; the increased conductivity is attributed to thermal ionization caused by the shock wave. The author notes that these conclusions agree with findings of Western investigators (references given) in studying the geomagnetic effects of nuclear explosions in the lower atmosphere.

Computations were made of (1) the current system which would arise as a result of local increase in E-layer conductivity and (2) the X- and Y-components of the magnetic field intensity of this current system at the surface of the earth. The method used by Nagata (reference given) was used in a modified form so that the initial equation was solved not for the potential of the electric field, but for the current function.

The Maxwell equations for a stationary current were used to compute the influence of the local increase of conductivity of the E-layer on the S_q-currents and S_q-variation of the geomagnetic field. Expressions are obtained for the current function inside and outside the local increase of conductivity.

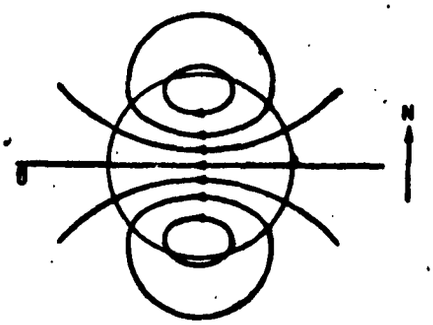

Fig. 1

Fig. 1 shows the form of the supplementary current system that would arise when the radius of the circular region is 1000 km, when the increase of conductivity in the center of the circle is 100% in comparison with the normal conductivity of the E-layer ($\gamma = 1$), and when the density of undisturbed S_q-current is $-1.5 \cdot 10^{-5}$ units CGSM. The center of the circular region lies on lat. $\sim 60°$ N and on the meridian corresponding to 1100 hours local solar time. It is seen from Fig. 1 that at points on the surface of the earth not lying beneath the region of increased conductivity, the supplementary current system attenuates the S_q-variation in the X-component. The S_q-variation in the X-component increases at points located beneath the region of increased conductivity in the sector between the foci of the northern and southern current vortices. The S_q-variation in the Z-component is increased by the southern current vortex and weakened at points located beneath the northern current vortex. The S_q-variation in the D-component is increased beneath the western half of the low-latitude vortex and beneath the eastern half of the higher-latitude vortex of the supplementary current system. The supplementary current equal to -7000 amp, amounting to -30% of the force of the undisturbed S_q-current flowing through this same sector, flows westward between the foci through the circular region. The value of the X-component at the point below the center of the region is -3.5γ. Computations were made of values of the X-component of the magnetic field of the supplementary current along the meridian passing beneath the center of the region, as well as values of the Y-component along the parallel passing beneath the focus of the southern current vortex. When the conductivity in the center increases by 300%, the amplitudes of the changes of the components along these sections are equal

to 10.5 and 6 γ, respectively.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Academy of Sciences USSR (Siberian Division).

11) Sukhorukova, E. V. Vertical distribution of electron density over Murmansk. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 904-908.

On the basis of data from the Murmansk vertical sounding station, the vertical distribution of electron concentration has been computed. Computations were made using the manual integral method (10 selected points) for one magnetically quiet day of each month of 1958. Electron profiles were constructed for the noon hours. The total electron content in the noon hours shows equinoctial maxima with a small minimum in winter and a large minimum in summer. The total number of electrons in an ionospheric column increases with a decrease in latitude. The presence of an equinoctial maximum indicates the significance of corpuscular radiation in the total amount of ionization in the ionosphere.

Author's Association: Polar Geophysical Institute, Academy of Sciences USSR (Kola Branch).

TOPIC III. VAN ALLEN BELTS AND COSMIC RAYS

1) Alekseyeva, K. I., L. L. Gabuniya, G. G. Zhdanov, Ye. A. Zamchalova, M. N. Shcherbakova, and M. I. Tret'yakova. Investigation of the composition of primary cosmic radiation at a height of 320 km. Iskusstvennyye sputniki zemli, no. 12, 1962, 6-15.

For their investigation, the authors made use of a small photoemulsion stack consisting of ten layers of НИКФИ-БР emulsions, about 100 sq cm in size and having a sensitivity to relativistic singly-charged particles of about 20 clusters per 100 μ. The stack was exposed for about 24 hours during the flight of Sputnik V (19 August 1960) at an average height of about 320 km between the latitudes -65 to +65°. Automatic measuring equipment developed by I. V. Shtranikh at ФИАН (Physics Institute, Academy of Science USSR) was also used. Block diagrams and a description of the operation of the equipment are provided. Multiple-scattering and ionization measurements were carried out separately. The mean length of track measured was about 10 mm; the measurement time was $\approx$ 7 min. During favorable operating conditions the resolution was sufficient to separate groups Li, Be, B and C, N, O. Results are shown in the table below.

Impulse pc, Bev	Relative nuclear flux	
	Li Be, B	C, N, O
> 1.5	18	45
0.8 - 1.5	29	32
Total	47	77

As is seen from the table, the ratio of intensities of the two groups of nuclei, Li, Be, B (light) and C, N, O (medium), is 0.60 ± 0.11. A tendency for this ratio to increase is noted in the 0.8 - 1.5 Bev region. This agrees with the findings of Aizu et al. (reference given).

2) Charakhch'yan, A. N., and T. N. Charakhch'yan. Sudden increases of cosmic-ray intensity in the stratosphere as related to chromospheric flares. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 829-835.

The relationship between sudden increases in cosmic-ray intensity in the stratosphere and chromospheric flares on the visible and averted faces of the sun is examined. On the basis of analysis of geophysical and radioastronomical phenomena (Forbush effect, magnetic storms, auroras, etc.) 17 out of 26 sudden increases of cosmic-ray intensity were attributed to flares on the visible side of the solar disk. The amplitudes of intensity of cosmic-ray particles associated with chromospheric flares on the visible side of the solar disk are greater than those attributed to flares on the averted face. This attests to the anisotropic diffusion distribution of protons in the interplanetary medium, caused apparently by the presence in space of weak magnetic fields oriented radially from the sun. The intensities of these magnetic fields should be of the same order of magnitude as those of the field of magnetic inhomogeneities that effectively scatter protons with energies of ~0.2 Bev.

A statistical correlation, made by the superposition of epochs, between sudden cosmic-ray increases and solar flares shows that the number of flares is twice that of cosmic-ray increases. The ratio of the number of sudden increases of cosmic-ray intensity to the number of flares is not constant but depends on the level of solar activity. The ratio was ~ 0.1 for 1958-1959 and ~ 0.5 for 1960-1961. Two explanations are offered: 1) With decreased solar activity the magnetic fields in the vicinity of the sun decrease, making it more possible for the cosmic rays generated on the sun to depart. 2) Chromospheric flares that generate cosmic rays may not stand in the same relationship to solar activity as do chromospheric flares in general.

Author's Association: Physics Institute im. P. N. Lebedev.

Comment: See also AID Work Assignment No. 3, Report 27, Topic III, Abstract 2.

3) Khorosheva, O. V. Daily drift of the closed ring of auroras. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 839-850.

On the basis of auroral observations made with C-180 cameras at Soviet stations during the winter of 1957-1958, it is concluded that auroras form a closed ring which encircles the entire globe. The ring has an irregular oval shape and is situated nonsymmetrically about the geomagnetic pole, being displaced towards the night side so that it passes above the main auroral zone at magnetic latitudes Φ=60-65, while the sector of the ring on the day side passes over higher latitudes

($\Phi \approx 75$-80). Owing to the rotation of the earth the ring completes a regular daily drift, as a result of which it will intersect the same terrestrial meridian at different latitudes, at different times. The radius of the auroral ring is such that when one sector of the ring on the night side of the earth is over the latitudes of the main auroral zone, the opposite sector is on the day side over the latitudes corresponding to the second inner zone. Consequently, both zones, the main and the inner, must be seen as the envelopes of instantaneous positions of a single closed ring of auroras. The daily drift of the ring may also be explained by the daily change of azimuths of auroral arcs. The presence of this single closed auroral ring can be attributed to the constant presence around the earth of corpuscular solar radiation trapped by the geomagnetic field. The daily regular drift of the ring in this case may be ascribed to the deformation of the magnetic field of the earth under the influence of solar wind.

Author's Association: Moscow State University; Institute of Nuclear Physics.

4) Loginov, G. A., M. I. Pudovkin, and R. G. Skrynnikov. Daily variation of the intensity of auroras and S_D-variations. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 855-860.

On the basis of electrophotometric observations of auroras made in 1961-1962 at the Lovozero Geophysical Station by the Polar Geophysical Institute and the Department of Geophysics of Leningrad State University, the distribution of auroral intensity throughout the day was examined. The luminosity of the entire sky in the 3500-6000 A sector of the spectrum was measured, with maximum sensitivity around 4000 A. Measurements were made on moonless nights. Round-the-clock observations of the variations of the geomagnetic field were made at the same time. Records of the three components (H, D, Z) of the geomagnetic field were entered at a rate of 20 mm /hr. Conclusions: 1) The intensity of auroral glow has one broad maximum covering the time from 1600 to 2400 hours GMT, with a peak value at around local midnight. 2) The existence of evening (1600-1700 hours GMT) and morning (0300-0400 hours GMT) maxima is likely. 3) The daily variation of the horizontal component of the field of magnetic disturbance δH, computed from known δI and v, on the basis of the dynamo theory, agree well in form with the observed δH variation. 4) The assumption that the S_D-variation is the result of the averaging-out of bay-shaped and irregular disturbances is confirmed.

Author's Association: Polar Geophysical Institute, Academy of Sciences USSR (Kola Branch).

5) Isayev, S. I. On the existence of a region of increased auroral activity in the middle latitudes. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 861-864.

In an earlier work (see AID Work Assignment No. 3, Report 29, Topic III, Abstract 5) the author showed that in addition to the Fritz zone of maximal frequency of auroral recurrence ($\Phi = 68°$), two other regions of increased auroral activity exist: region M (middle-latitude), located in the $\Phi = 58\text{-}52°$ latitude belt, and region H (high-latitude), adjoining the main Fritz zone on the south and located in the $\Phi = 66\text{-}64°$ latitude belt. The middle-latitude region exists during strong geomagnetic storms and increases during years of maximum solar activity. The high-latitude region arises during moderate geomagnetic disturbances, remains during large storms, and is weakly developed during years of minimum activity. These observations have now been confirmed on the basis of investigations of zenithal auroras.

Since with the detection of increased auroral activity in the middle-latitude region it was noted that the hydrogen emission in the auroras was displaced to the south of the main zone ($\Phi = 68°$) during geomagnetic disturbances, attempts were made to determine whether the most frequent appearance of hydrogen emission during storms in years of high solar activity coincides with the middle-latitude M region. Detailed observations were therefore made of hydrogen emission during IGY and IGC in Murmansk, using the patrol spectrograph C = 180 = S, making it possible to photograph the spectrum of the sky band passing through the arc of a vertical of 180° length. It was found that the maximum number of cases of H_α emission was recorded in the region of $\Phi \simeq 60°$, located 2° north of the southern boundary of auroras in zenith. The region is near $\Phi = 58°$, i.e., between the middle-latitude M region ($\Phi = 50\text{-}56°$) and the high-latitude H region (66-64°) whose existence was previously linked with the outer and third radiation belts. Thus, the hydrogen emission is probably limited to the region between these two radiation belts.

Author's Association: Polar Geophysical Institute, Academy of Sciences USSR (Kola Branch).

6) Nadubovich, Yu. A. On the different indices of auroral activity. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 1008-1010.

The different indices now used to describe auroral activity (A - frequency of appearance and brightness; P - mean hourly frequency of appearance; and B - the mean hourly brightness) are briefly discussed, and the need for still another index to indicate auroral mobility and changeability in time is expressed. A three-unit scale is proposed for this purpose:

0 - quiet, very slight motion; 1 - auroras the motion of which is easily observed after about one minute, relative movement of sectors, arc bendings; 2 - chaotic movement of auroras, rapid pulsations. It is further proposed that a scale, similar to the one used in meteorology to estimate cloud cover, be used to determine the area covered by auroras.

Author's Association: Yakutsk Branch, Siberian Division, Academy of Sciences USSR.

TOPIC IV. TELLURIC CURRENTS

1) Smirnov, R. V. On short-period train-like pulsations of the natural electric field in the sea. IN: Akademiya nauk SSSR. Doklady, v. 145, no. 6, 1962, 1271-1274. AS262.S3663 v. 145.

Records of variations of the natural electric field in the Black Sea from May 1959 through May 1961 have been analyzed. Two mutually perpendicular bases, the larger of which was located parallel to the shore to eliminate Faraday currents, constituted the fixed installation. Nonpolarizing graphite electrodes were used for contacts. The signals were recorded on ЭПП-09 electronic potentiometers at a rate of 240 mm/hr. Similar electrodes were used to measure telluric currents in the coastal region. Comparison of pulsation trains in the sea and upper ground layer showed that the intensity of the former is on the average one and a half times higher than the latter. Taking into account the conductivities of sea water and the rocks of the coastal region, it is seen that the current densities in the sea exceed those on dry land by several hundred times. The most characteristic intensities of pulsation trains of the electric field in the sea is 5 - 15 mv/km, maximal values reaching 35 mv/km. The periods of the marine pulsation trains do not differ from the telluric and change for the most part from 50 to 90 sec. No relationship was found between the amplitude and period magnitudes.

The absence of "polar night effect" for the pulsation trains and cases of their simultaneous appearance over enormous areas suggest that the time of excitation of the pulsation trains is not determined by illumination alone and is therefore not controlled by local time, as has been hypothesized by Dubrovskiy, Okhatsimskaya, and Rastrusin (references given). The seasonal curve of the pulsation trains is characterized by a sharp increase in the frequency of their appearance during the equinoctial periods. This is held to indicate a relationship between the appearance of pulsation trains and active solar regions. A 27-day recurrence rate is also noted in the appearance of the pulsation trains. Like the corpuscular streams that create M-disturbances, the streams responsible for the excitation of pulsation trains may owe their origin to the development of local magnetic fields, the number and intensity of which increase near active regions. The rather stable appearance of the pulsation chains on successive days is, by analogy with M-disturbances (see Mustel', AID Work Assignment No. 3, Report 5, Topic II, Abstract 2), related to the formation of magnetic force tubes above the radiation source.

Author's Association: Black Sea Division, Marine Hydrophysical Institute, Academy of Sciences Ukr. SSR.

TOPIC VII. SATELLITE AND MISSILE DATA

1) Ruskol, Ye. L. On the origin of the concentration of interplanetary dust around the earth. Iskusstvennyye sputniki zemli, no. 12, 1962, 145-150.

Whipple's theory attributing the concentrated dust cloud around the earth to meteorite impacts on the moon is rejected. It is proposed, rather, that the capture of interplanetary particles in circumterrestrial orbits (caused in part by their inelastic collisions in the vicinity of the earth and by braking in the thin layer of the upper atmosphere) satisfactorily explains the observed dust concentration at distances from 500 to 1000 km and beyond from the surface of the earth, i.e., the outer part of the concentration, which accounts for about 0.9 of its entire mass. The inner part of the concentration, however, from 100 to 300 km above the surface of the earth, is apparently caused by the trapping in the upper atmosphere of a direct stream of particles by the earth. A Venus probe could verify this. Venus, moving like the earth, within the zodiacal cloud of particles, should have acquired the same concentration, perhaps even more dense, since the density of the zodiacal cloud increases towards the sun. Verification of the cloud in the case of Venus would definitely invalidate Whipple's theory of lunar origin.

2) Nazarova, T. N. Investigation of meteoric dust by rockets and artificial earth satellites. Iskusstvennyye sputniki zemli, no. 12, 1962, 141-144.

The results of direct investigations of meteoric dust made by rockets and satellites are presented. Measurements were made by ballistic piezoelectric sensors that record the number of particle impacts and the impulse generated as the meteoric particle impinges against the surface of the sensor. In processing the experimental data the dependence of the impulse I on the energy E of the particle in the form $I = AE$ was assumed. The law $I \sim E$ is not everywhere accepted (e.g., Lavrent'yev assumes that $I \sim (mv)^{1.8}$, while American investigators take $I \sim mv$ [m is the mass of the particle]). It is found that the density of meteoric matter in the vicinity of the earth is not stable. At heights of 100-300 km changes in the number of impacts N in time do not exceed one and a half orders. At heights of 400-2000 km sporadic increases of N are observed. On 15 May 1958 the third artificial satellite recorded from 4 to 11 impacts $\cdot m^{-2} \cdot sec^{-1}$. On 16-17 May the stream decreased to $5 \cdot 10^{-4}$ impacts $\cdot m^{-2} \cdot sec^{-1}$ (m is $6 \cdot 10^{-8}$ g), which is apparently normal for these heights. Inasmuch as the frequency of impacts changes with a period equal to the period of precession of the satellite, the effect cannot be attributed to the equipment.

TOPIC IX. METEOROLOGY OF THE UPPER ATMOSPHERE

1) Pokhunkov, A. A. Changes in the mean molecular weight of air in the night atmosphere at heights of from 100 to 210 km as detected by mass spectrometric measurements. Iskusstvennyye sputniki zemli, no. 12, 1962, 133-140.

An experiment, involving the use of a five-cascade radio-frequency mass spectrometer, was conducted on 23 Sep 1960 in the middle latitudes of the European USSR to investigate the composition of the atmosphere. Fifty mass spectra were obtained during the ascent, and 51 during the descent of the container between heights of 100 and 210 km. The relative concentrations and changes with height of the basic atmospheric components determining the mean molecular weight of the air were examined. Molecular nitrogen and atomic and molecular oxygen are the basic components within the investigated range of altitudes, with molecular nitrogen predominant throughout. The content of atomic nitrogen at these heights does not exceed 2% of the concentration of molecular nitrogen. The relative concentration of atomic oxygen with height increases about five times and at 210 km amounts to about 65± 20% of the concentration of molecular nitrogen. The relative concentration of molecular oxygen at about 100 km is almost equal to the concentration at the ground layer. With increased height it decreases by about one-half, amounting to 14± 6% of the concentration of molecular nitrogen at 210 km. These ratios are shown graphically. Fig. 1 shows the distribution of the relative concentrations of the three components with height; Fig 2, the change in the mean molecular weight of air in the height range from 100 to 210 km.

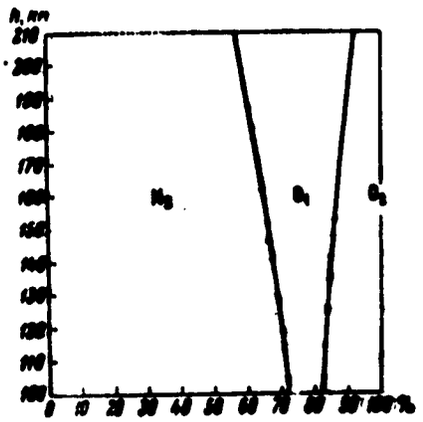

Fig. 1. Distribution of relative concentrations of N_2, O_1, and O_2 by height.

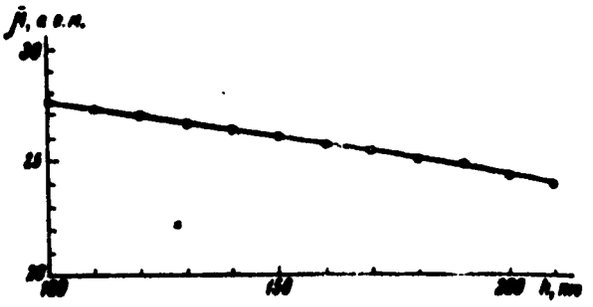

Fig. 2. Change in mean molecular weight of air as a function of height.

The degree of dissociation of molecular oxygen at different heights is also computed. An increase in the amount of dissociated oxygen with height is noted, though there is still a significant amount of molecular oxygen at 210 km, which leads the author to conclude that the influence of diffusion mixing at these heights is considerable.

2) Derpgol'ts, V. F. On the exchange of water between the earth and outer space. IN: Geograficheskoye obshchestvo SSSR. Geograficheskiy sbornik, v. 15 (Astrogeologiya), 1962, 198-207. G58. G34 v. 15

In a highly speculative article the exchange of water between the earth and outer space is discussed. The material is presented in several sections: 1) the origin of water on the earth, 2) water in outer space, 3) the arrival of water from outer space on the earth, 4) the escape of water from the terrestrial atmosphere into space, and 5) the practical significance of ice found in space. It is estimated that if the content of water in the cosmic material falling onto the earth during the $5 \cdot 10^9$ years of the earth's history is put at 0.5%, then the total volume of water received from space has amounted to $3.5 \cdot 10^{14}$ m^3. This is the equivalent of a 2-m layer over the entire earth's surface. Against this, it is estimated that in the $5 \cdot 10^9$ years of the earth's existence, hydrogen from $6.5 \cdot 10^{35}$ molecules of water have escaped into space. This would correspond to a 25-m water column over every square centimeter of the earth's surface.

Satellites are reported to be studying a new source of hydrogen, formed in the upper layers of the atmosphere owing to a proton-electron plasma ejected by the sun and forming the solar corona, which reaches the region of the earth's ecliptic. Particles of cosmic origin in the form of protons can, after electron capture, also form hydrogen atoms. Hydrogen from either of these sources in the upper atmosphere can, under the influence of solar radiation, combine with oxygen atoms into water molecules. It is speculated that noctilucent clouds in the form of ice crystals may be composed of this kind of primary water, the hydrogen of which is of cosmic origin. Counterglow and zodiacal light are discussed in the light of Fesenkov's hypothesized terrestrial gas tail. Robey's work, "Ice in Space," is critiqued and the possible use of ice to protect rockets against meteorites noted.

3) Yatsenko, S. P. On some altitude-distribution patterns of ion concentrations in the atmosphere. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 873-877.

It is stated that experimental data on the altitude distribution of absolute ion concentrations make it possible to gain an idea of the chemical processes involved in the disappearance of ions in the atmosphere. An attempt is made to explain

certain distribution patterns, proceeding from the assumption that ion concentrations are influenced by three processes: direct ionization due to radiation, ion-exchange reactions, and recombination with electrons. The method of analysis used by the author differs from Chapman's theory of the simple layer in that it takes into account ion-exchange reactions in the ionosphere.

Experimental data presented in graphic form show that the concentrations of the molecular ions O_2^+ and NO^+ have a maximum at a height of about 225 km. The concentration of ions of molecular nitrogen N_2^+ have a maximum at a height of 250 km. Above 250 km the concentrations of molecular ions fall off quickly, and at a height of 400 km they differ from the maximum concentrations by about one order of magnitude. The concentrations of the atomic ions O^+ and N^+ increase up to a height of 300 km and remain more or less constant at 300-400 km.

On the basis of these data it is concluded that the molecular ions NO^+, O_2^+ and N_2^+ in the atmosphere disappear through dissociative recombination, while the atomic ions O^+ and N^+ disappear through recharging. This condition agrees with that arrived at by Danilov (reference given) on the basis of photochemical analysis.

Author's Association: Institute of Applied Geophysics, Academy of Sciences USSR.

BIBLIOGRAPHY

1) Alekseyeva, K. I., L. L. Gabuniya, G. B. Zhdanov, Ye. A. Zamchalova, M. N. Shcherbakova, and M. I. Tret'yakova. Investigation of the composition of primary cosmic radiation at a height of 320 km. Iskusstvennyye sputniki zemli, no. 12, 1962, 6-15.

2) Bukin, G. V. Geographical distribution of f_0E and some properties of the E-region in the Antarctic. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 918-924.

3) Charakhch'yan, A. N., and T. N. Charakhch'yan. Sudden increases of cosmic-ray intensity in the stratosphere as related to chromospheric flares. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 829-835.

4) Derpgol'ts, V. F. On the exchange of water between the earth and outer space. IN: Geograficheskoye obshchestvo SSSR. Geograficheskiy sbornik, v. 15 (Astrogeologiya), 1962, 198-207. G58.G34, v..15

5) Gringauz, K. I. Structure of the ionized gaseous envelope of the earth as determined by direct measurements of local concentrations of charged particles, carried out in the USSR. Iskusstvennyye sputniki zemli, no. 12, 1962, 105-118.

6) Isayev, S. I. On the existence of a region of increased auroral activity in the middle latitudes. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 861-864.

7) Ivanov, K. G. Effect of local increase of conductivity of the E-layer of the ionosphere on the S_q-variation of the terrestrial magnetic field. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 943-948.

8) Jasiński, Stefan. Eclipse effects in the ionospheric E-layer observed at Miedzeszyn on 15 February 1961. Acta geophysica polonica, v. 10, no. 3, 1962, 225-237.

9) Karimov, M. G. Results of comparing systematic observations of the corona at different stations in 1961. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 76-80.

10) Karimov, M. G., and M. I. Antushevich. Flare and emission lines of the solar corona. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 86-92.

11) Karimov, M. G., and S. K. Dosybayev. Low-latitude filament and active prominences of 2 September 1961. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 81-85.

12) Karimov, M. G., A. S. Zubtsov, M. I. Antushevich, and S. K. Dosybayev. Photometry of solar flares. IN: Akademiya nauk Kazakhskoy SSR, Alma-Ata. Astrofizicheskiy institut. Izvestiya, v. 14, 1962, 93-106.

13) Khorosheva, O. V. Daily drift of the closed ring of auroras. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 839-850.

14) Loginov, G. A., M. I. Pudovkin, and R. G. Skrynnikov. Daily variation of the intensity of auroras and S_D-variations. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 855-860.

15) Nadubovich, Yu. A. On the different indices of auroral activity. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 1008-1010.

16) Nazarova, T. N. Investigation of meteoric dust by rockets and artificial earth satellites. Iskusstvennyye sputniki zemli, no. 12, 1962, 141-144.

17) Pokhunkov, A. A. Changes in the mean molecular weight of air in the night atmosphere at heights of from 100 to 210 km as detected by mass spectrometric measurements. Iskusstvennyye sputniki zemli, no. 12, 1962, 133-140.

18) Ruskol, Ye. L. On the origin of the concentration of interplanetary dust around the earth. Iskusstvennyye sputniki zemli, no. 12, 1962, 145-150.

19) Shul'gina, N. V. Ionospheric disturbances as observed at Murmansk station. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 878-885.

20) Smirnov, R. V. On short-period train-like pulsations of the natural electric field of the sea. IN: Akademiya nauk SSSR. Doklady, v. 145, no. 6, 1962, 1271-1274. AS262.S3663, v. 145

21) Sukhorukova, E. V. Vertical distribution of electron density over Murmansk. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 904-908.

22) Tsedilina, Ye. Ye. Doppler effect in a magnetically active ionosphere. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 865-872.

23) Yatsenko, S. P. On some altitude-distribution patterns of ion concentrations in the atmosphere. Geomagnetizm i aeronomiya, v. 2, no. 5, 1962, 873-877.